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A FIELD ASSESSMENT OF A PERMETHRIN-BASED  
INSECT REPELLENT FOR ARMY CLOTHING

J. M. FROST, G. SOUTHWELL and L. B. SPAANS

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## A Field Assessment of a Permethrin-Based Insect Repellent for Army Clothing

Janet M. Frost, Gordon Southwell  
and Leendert B. Spaans

MRL Technical Report  
MRL-TR-89-34

### Abstract

Since the high activity of biting flies and insects in the Australian terrain may cause subsequent disease or discomfort soldiers must be protected to maintain their efficiency and health. The issued "insect repellent - clothing", while effective, has some undesirable characteristics and is not popular with service personnel.

During a battalion exercise in Northern Queensland the use of a synthetic pyrethroid was investigated with "in the field" application as a paramount objective. The product used appeared to be effective in bite inhibition, was acceptable to the user and could easily be used for such a purpose particularly if pre-metered doses were packaged in sealed sachets.

*insect repellent sachets*

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## **A Field Assessment of a Permethrin-Based Insect Repellent for Army Clothing**

### **1. Introduction**

The high insect activity in the Australian terrain requires the soldier to continually apply insect and mite repellent to prevent bites and subsequent disease. The Army currently have two items for this purpose. Insect repellent-clothing is applied to the clothing to prevent access of mites and ticks to the body. Insect repellent-personnel is for use on exposed areas of skin and is recommended for use against biting insects. This product consists of approximately 95% N, N-diethyl m-toluamide in ethanol as solvent and is commercially referred to as DEET.

The commercial material was withdrawn early in 1988 due to a case where DEET was directly linked to a child's death. After investigation the product was, however, reinstated since it was found that the product had been grossly misused. Most commercially available products contain much lower concentrations of DEET in their formulation than that used by the military. Clothing to which this liquid has been applied tends to attract dirt and contact of the repellent with plastic components causes such items to soften and distort. As a consequence many soldiers purchase commercial repellents. Some of these products, however, are strongly perfumed and can lead to detection in a field environment where concealment is important. These problems have led Army to investigate alternative products.

Investigations in Australia and other countries, particularly Canada and USA, have indicated that synthetic pyrethroids are effective as contact poisons and have a broad spectrum of insecticidal activity [1-18]. Wellcome Australia Ltd market such a product, under the trade name Perigen, which contains 10% w/v permethrin which is a member of the new generation synthetic pyrethroids.

Perigen is one of the products approved for use on wool containing fabrics used by Australian Defence Forces. It functions as a resist agent for protection against damage by clothes moths, carpet beetles and other insects. During the early development stages of the Disruptive Pattern, Camouflage Printed, Combat Uniform in 1983, MRL workers decided to investigate the potential of Perigen as a possible method of protection against biting insects when applied to non wool clothing by simple techniques. The product is not a repellent and therefore offers no protection to exposed skin areas. The insect repellent-personnel is still required to protect these areas.

During a battalion exercise held in Shoalwater Bay Training Area, north of Rockhampton, lat. 22° S, long. 150° E, over August/September 1988, 8/9 RAR offered to participate in a trial to evaluate a method of application of Perigen which would be suitable for field use.

The objectives of the trial were:

- (a) to evaluate a method of application for a permethrin based insect repellent "Perigen" to determine if the method could be used in the field;
- (b) to assess if the method of application produced an effective level of permethrin on the garments.

The levels of application of Perigen and the procedure for application were based on the recommendations by Wellcome Australia Ltd. It was decided to use the minimum volume of water for each set of clothing to simulate field conditions, where very limited water, especially for washing clothes, may be available.

Half of the members of each company had their clothing treated with Perigen and the remaining members used the usual methods of protection against insects and biting flies. MRL staff co-ordinated the application procedure, developed a questionnaire which was completed by all participants, conducted interviews on completion of the trial and undertook detailed analysis of the data.

A comparison was made between the insect activity affecting the soldiers with treated clothes and those with untreated clothes from the questionnaires and interviews with the participants. Analysis of the returned fabric swatches provided information on the effectiveness of the application procedure and the durability of the Perigen on the clothing.

## 2. Experimental

Two fabric samples for each participant were prepared at MRL prior to the trial. These were placed in the pocket of the shirt during the trial and were used to determine the level of Perigen remaining on the clothing at the completion of the exercise. As Jungle Greens were the most common uniforms worn during the trial the fabric samples were cut from a cloth of similar construction and weight to the fabric used in the Jungle Greens. This fabric was washed prior to the application of Perigen to remove any residual processing chemicals. Fabric details and processing are outlined in Appendix A. One fabric swatch in each set did not undergo any further treatment after washing and remained blank. These cloths were referred to as blank samples throughout the trial. The second fabric swatch was treated with Perigen according to the recommendation in a report by Wellcome Australia Limited. After drying, this swatch was stamped with the words "MRL CONTROL" using a waterproof ink. These cloths were referred to as the control samples and details of this procedure are given in Appendix B.

Immediately prior to the Perigen application at Enoggera Barracks in Brisbane a briefing was given to all available participants. Information concerning the product and its use was made available before the briefing to allow participants to familiarise themselves with the purpose of the exercise and to prepare their clothing. A copy of these details is shown in Appendix C. The briefing covered the objectives of the trial, the nature of the product and the application procedure. The importance of ensuring that the garments were completely wet out was stressed. Section leaders were asked to record data on the weather conditions, the level of activity of the soldiers and the incidence of insects. After the briefing, personnel gathered with their clothing and the application of Perigen was supervised by staff from MRL and Staff Officer Science.

Each participant of the Perigen trial was given one blank fabric sample. Name and identification were clearly marked on the cloth and then it was placed in the shirt pocket. All garments to be worn by each soldier during the trial were placed in a large plastic bag and the weight of each bag was taken. A bulk solution of Perigen was prepared in two large garbage bins which had been lined with plastic bags. The solution consisted of 1 part Perigen to 49 parts tap water. The bags were worked to ensure the garments were completely wet out before hanging the clothes up to drip dry.

Section leaders were supplied with the fabric swatches labelled "MRL CONTROL" which were to be issued to each participant for placing in the other pocket of the shirt when the clothing was dry. Unfortunately not every soldier was given this swatch.

Participants of the trial were asked not to use the issued insect repellent-clothing or any other product which required application on to clothing. They were advised to protect any areas of exposed skin with the issued insect repellent-personnel or an equivalent product.

The Army exercise was held in the Shoalwater Bay Training Area from 17-28 September 1988. On completion of the exercise the fabric swatches were collected and each participant completed the questionnaire shown in Appendix D. Members of the company with untreated clothing completed the questionnaire shown in Appendix E. The untreated participants were the control population for comparison between treated and untreated clothing. Ten percent of the returned fabric swatches were sent to Wellcome Australia Limited for analysis of the level of Perigen remaining on the fabric.

Personnel from A,B, C Company, the Mortar Platoon and Recon Patrol participated in the exercise. A,B,C Company and the Mortar Platoon were engaged in exercises along Shoalwater Creek. The Recon Patrol carried out sea immersions and water operations for several days and patrolled the mangrove area for the remaining time. Details of weather conditions and insect activity are shown in Appendix F.

### **3. Results and Discussion**

Seventy six personnel from 8/9 RAR applied Perigen to their clothing. Personnel were selected from each company to ensure both treated and untreated soldiers were in the same area. Weather and insect activity records were kept by each section. On completion of the exercise the two fabric swatches from each shirt pocket were collected for analysis and all participants filled in a questionnaire.

#### **QUESTIONNAIRE**

At the time of preparation of the questionnaire the insect population likely to be encountered was unclear and for this reason the questions were designed to cover all possibilities. The main insects encountered were mosquitoes, ticks and sandflies. There were no reports of any mite infested areas.

#### **3.1 Untreated Clothing**

Eighty five questionnaires were completed by soldiers who had no Perigen treatment on their clothing. There was no significant difference in the spread of answers for people from A,B,C Company and the Mortar Platoon. Each covered similar terrain along Shoalwater Creek and the insect activity encountered was the same. These four units were grouped together and treated as one for the remainder of the analysis. The Recon patrol were located in mangroves and took part in several

seawater immersions. They were therefore considered as a separate unit. The results are shown in Appendix E, where the number in the box indicates the number of times the answer was chosen. Some participants did not answer all the questions and in Question 6 some multiple answers were given. Questions 2 and 7 and Questions 8 and 12 were used to verify the validity of the information. If the two answers in either of these sets were different then the questionnaire was eliminated from the data because of unreliability and for this reason the total number of answers is not constant.

### 3.2 Treated Clothing

A total of fifty (65.8%) questionnaires were completed and returned by soldiers who had worn the clothing treated with Perigen. The validity of the answers was checked in the same manner as for the untreated clothing cases.

The Recon patrol was again treated separately from the other unit which includes A,B,C Companies and the Mortar Platoon. Results are shown in Appendix D.

### 3.3 Comparison

The questionnaires returned from the Recon patrol personnel show that insect/mosquitoes were encountered often (Q.5). When comparing the number of bites which occurred through the clothing (Q.8) the soldiers wearing treated clothing experienced far fewer bites than the untreated cases. One person in the treated group required medical attention for a tick which was located on the rear of his neck. Three soldiers in the untreated group required medical attention for sandfly bites. None of the medical cases was of a serious nature. The answers to Question 13 show no significant difference between the treated and the untreated groups. All three soldiers in the treated group indicated they would use the product again as they felt that it did give increased protection against insects/ticks.

The answers for Question 5 from the remainder of the companies show some variation between the treated and untreated groups. The results would seem to indicate that the treated group encountered less insect population than the untreated group. This phenomenon has been noted in several previous reports and is attributed to the fact that Perigen is an insecticide and kills the insect rather than repelling it. This reduces the local population of insects in the vicinity of the treated person.

The response to Question 8 suggests a significant difference in the number of bites experienced through the clothing between the treated and the untreated group. Sixty one percent of the treated group did not experience any bites while only eight percent of the untreated group had no bites. When the two options of biting frequency in Question 8 (often and very often) are combined only fifteen percent of the treated group indicated this answer compared with eighty six percent from the untreated group.

The answers to Question 11 again reflects that the treated group required far less medical treatment than the untreated group. Most treatment was for sandfly bites and there were no cases of insect/tick bites which required the person to be evacuated out of the area.

Question 13 shows the same trend as the previous questions with sixty one percent of the treated group untroubled by ticks while only eight percent of the untreated group were untroubled. Forty five of the treated group said that they would use the product again and three said that they would not.

Some of the comments received from the yes answer are shown in Appendix G. One soldier who indicated that he would not use the product stated as the reason 'Because it did not work and it made a rash of mine come up again'. His questionnaire indicated that he had experienced many bites through the clothing. He did not have any fabric samples in his pockets and said that they had been lost. A sample of the shirt material was requested from this person but was not received. The medical



officer indicated that the rash was a pre-existing condition and did not attribute it in any way to the product applied. As we could not acquire any evidence to show that Perigen had been applied to the clothing of this person it was considered that this negative comment should not be included in the final numbers. The remaining two soldiers who indicated that they would not use the product again had experienced a large number of bites through the clothing and felt that it was not effective. However one of these indicated that the product was effective for 75% of the trial (Q.15) and that it did give more protection than untreated clothing (Q.17).

### 3.4 Fabric Sample Results

Thirty five "MRL CONTROL" fabrics and thirty nine blank fabric samples were returned from the trials. In this selection there were twenty nine complete sets containing the two fabrics. Soldiers who had lost both fabric samples were asked to cut a small sample from the tail of the shirt. Four samples were obtained in this manner.

The total number of returns was restricted by the inability to locate all participants of the trial during the visit to Shoalwater Bay Training Area. Ten percent of the fabric samples returned from the trial were analysed by Wellcome and a copy of the results is given in Appendix H. The solution applied to all of these samples contained 0.2% w/w permethrin. This is equivalent to 0.24% w/w permethrin. The fabrics labelled "MRL CONTROL" show levels of permethrin which vary from 0.5 to 0.35% w/w permethrin. In some cases this would appear to be a higher concentration than was in the original solution. As stated in the method for preparation of the Control samples, each sample was weighed and then the weight adjusted to the next gram. For example, if the original sample had a weight of 4.2 grams the weight was recorded as 5 grams. Five mls of the 0.2% Perigen solution added to this cloth would increase the level of application by 20% with 0.29% w/w permethrin being added on to the sample. The Perigen used for preparation of the Control samples had been stored at MRL for several years and may have increased in concentration due to evaporation of the solvent. This would further increase the level of permethrin applied to the fabric samples. One additional possibility which must be considered is the presence of permethrin in any insect repellent which was applied to exposed areas of skin. Many of the soldiers carried the containers of insect repellent in shirt pockets and any leakage could leach on to the fabric samples. This possibility was discarded after discussion with Wellcome Australia Laboratories, since their analysis showed a 25:75 cis/trans ratio of the detectable permethrin in the sample. As the other permethrin products available use a 40:60 cis/trans ratio of permethrin, any contamination from this source would have been clearly evident during the analytical procedure.

The blank samples which were placed in the shirt pocket during the treatment of the clothing showed a range of permethrin values from 0.07 to 0.23% w/w permethrin. The fabric cut from the shirt had values ranging from > 0.01 to 0.16% w/w permethrin. Sample H returned a value of less than 0.01% w/w permethrin. This value is the value normally returned from a blank sample which has no treatment. If a treated sample has been washed several times it is still possible to pick up some level of permethrin remaining on the cloth. This would indicate the sample was obtained from a shirt which had not been treated with Perigen.

The report by Wellcome refers to a target dose rate but does not provide any indication of the minimum effective level of permethrin. If the samples analysed had levels which were below the effective level then further work would need to be carried out to investigate the effect of applying a higher initial concentration of permethrin and the effect of applying Perigen using hot water.

### 3.5 General Discussion

When the units were visited to collect samples and questionnaires it was noticeable that many personnel had sandfly bites on their arms and around their necks. The soldiers who had treated clothing showed little or no evidence of sandfly bites. After this became apparent it was possible to distinguish the soldiers who had treated clothing by the lack of sandfly bites. The soldiers who had worn the treated

clothing were very enthusiastic about the product and related incidents when they had been lying in the grass with sandflies landing on their clothing. When the soldiers moved the sandflies would drop off and appeared to be dead. One soldier who had no treatment on his clothing felt that he had been discriminated against as he was covered in sandfly bites while three other members of his unit whose clothing was treated had no bites at all.

#### 4. Conclusions

1. The method of application would appear to be acceptable and could easily be used in the field. The use of a sealed sachet containing the Perigen would eliminate the need to make a bulk solution.
2. The reasons for the high Perigen content of the sample swatches used as controls should be examined further.
3. There were significant differences in the number of insect bites for soldiers wearing untreated clothing compared with those wearing treated clothing. These results indicate that the product does give significant protection from biting flies and insects.
4. The use of the product Perigen was acceptable to the soldiers.

#### 5. Acknowledgements

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## **Appendix A**

### **Details of Fabric Samples**

A white cotton drill loomstate cloth was available. The weight of the cloth was approximately 290 grams per square metre. This cloth, which was chosen since it had a similar construction and weight to the cloth used in the Jungle Green Uniform, was cut into squares approximately 100 mm x 100 mm which matches the inner dimension of the pockets on the shirt of the Jungle Green Uniform. All the fabric samples were given an alkaline wash to remove all oils, then bleached and dried. This treatment ensured that the cloths would readily wet out when immersed in the permethrin liquor. They were then separated into two sets each containing one hundred swatches. One set was treated with Perigen at MRL, the other did not undergo any further laboratory treatment.

## **Appendix B**

### **Preparation of "MRL CONTROL" Sample**

The mass of each prepared fabric sample was determined to the next nearest gram.

Each fabric sample was then placed into a small plastic bag. A solution of Perigen was prepared using the recommended dilution of 1 part Perigen to 49 parts water which produces a concentration of 0.2% w/v of permethrin. The water was normal cold water tap supply. One ml of solution for each gram of cloth was added to each bag which was then worked by hand to ensure the sample was completely wet out and no residual solution was in the bag. The fabric samples remained in the bags for approximately 30 minutes and were then removed and placed in a drying oven. When the samples were dry they were stamped with the words "MRL CONTROL" using a waterproof ink. One fabric sample from this set was sent to Wellcome Australia Limited for analysis.

## Appendix C

### Articles Sent with Information on Perigen to Enoggera Barracks

S.P. Frances (1987). Effectiveness of Deet and Permethrin, Alone and in a Soap Formulation as Skin and Clothing Protectants Against Mosquitoes in Australia. *Journal of the American Mosquito Control Association*, 3 (4), 648.

C.E. Schreck, K. Posey and D. Smith (1978). Durability of Permethrin as a Potential Clothing Treatment to Protect Against Blood-feeding Arthropods. *Journal of Economic Entomology*, 71 (3), 397-400.

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## Appendix D

### Perigen Treated Clothes

#### Questionnaire - Treated Clothes

One questionnaire is to be filled out by each participant of the Perigen Trial.

Name and identification should be clearly written on the front sheet of the questionnaire.

Questionnaires to be returned to nominated officer on completion.

A number of questions will be asked regarding your use of the insect and arthropod repellent, Perigen. After each question a series of boxes will be shown with several options to which you should respond with one answer, unless otherwise stated. Indicate your choice by placing a tick in the selected box as shown in the example question below.

Q: Indicate the number of times you used the issued mite repellent during the trial.

	0	1	2	3 or more
A:	.....	✓.....	.....	.....

NAME: .....

RANK: .....

UNIT: .....



1. How much of the time on the trial did you wear the treated clothes?

0	25%	50%	75%	100%	
	2	1	10	33	A,B,C Coy and Mortar Platoon
			1	2	Recon Patrol

2. Indicate the number of times you washed the treated clothes during the trial.

0	1	2	3	4 or more	
43	3				A,B,C Coy and Mortar Platoon
	1	2			Recon Patrol

3. If whilst wearing the treated clothing you were immersed in water, indicate the level of immersion and the frequency at each level.

0	1	2	3	4 or more	
21	7	5	4	8	A,B,C Coy and Mortar Platoon
				1	Recon Patrol

Above the knees but below the waist

0	1	2	3	4 or more	
31	10	1	1	1	A,B,C Coy and Mortar Platoon
				1	Recon Patrol

Above the waist but below the chest

0	1	2	3	4 or more	
38	4			1	A,B,C Coy and Mortar Platoon
			1		Recon Patrol

Above the chest

0	1	2	3	4 or more	
40	2				A,B,C Coy and Mortar Platoon
		1	1	1	Recon Patrol

4. Describe the weather you encountered during the trial?

Hot/Wet	Cool/Wet	Hot/Dry	Cool/Dry	
		46	1	A,B,C Coy and Mortar Platoon
		3		Recon Patrol

5. Indicate the occurrence of biting insects/mosquitoes which you encountered during the trial.

None	Hardly any	Often	All the time	
3	19	20	6	A,B,C Coy and Mortar Platoon
			3	Recon Patrol

6. Which one or more of the following is true?

		A,B,C Coy & Mortar Platoon	Recon Patrol
Insect attacks occurred	Mainly at night	22	
	Mainly at sunset	28	2
	Mainly at sunrise	11	3
	During the day	3	
	All the time	5	
7. The treated clothes were washed	More than 3 times		
	Three times		
	Two times		2
	Once	3	
	Never	42	

8. Indicate the number of times you were bitten by insects/flies through the treated clothes.

Never	Once	Twice	Often	Very often	
29	5	6	7		A,B,C Coy and Mortar Platoon
1		2			Recon Patrol

9. Indicate the number of times you applied the issued insect repellent - personal during the trial.

	A,B,C Coy & Mortar Platoon	Recon Patrol
Never	31	3
Once a day	10	
Twice a day	4	
Three times a day	1	
More than three times a day		

10. Did you use an insect repellent other than the issued item?  
If so, please indicate the brand, the reason for using this in preference to the issued item, and the number of times it was applied.

	RID	DEET	OTHER (Please specify)
Brand	38	1	3
	2		1
			A,B,C Coy and Mortar Platoon
			Recon Patrol

Reason for using an alternative insect repellent (please tick)

A,B,C Coy and Recon Patrol  
Mortar Platoon

1	1	Issued item not available
24		Brand items are more effective
12	1	Do not like issued item
5		Others (please specify)

Number of times you applied the alternative insect repellent

	A,B,C Coy & Mortar Platoon	Recon Patrol
More than three times a day	2	
Three times a day	1	
Twice a day	14	3
Once a day	21	
Never	7	

11. How often did you require first aid or medical treatment for any insect or mite related attack.

0	1	2	3	4 or more	
48	1	1			A,B,C Coy and Mortar Platoon
2			1		Recon Patrol

12. Which of the following is true?  
Insect bites occurred through the treated clothing

	A,B,C Coy & Mortar Platoon	Recon Patrol
Very often - more than 10 times	2	
More than 5 times but less than 10	6	
Twice	7	2
Once	5	
Never	28	

13. Were you troubled by mites/ticks during the trial?

Never	Hardly ever	Often	Very often	All the time	
29	13	4	1		A,B,C Coy and Mortar Platoon
1	1		1		Recon Patrol

14. How frequently did you apply the issued insect repellent - clothing (mite repellent) during the trial?

0	1	2	3	4 or more	
42	3	1		2	A,B,C Coy and Mortar Platoon
3					Recon Patrol

15. For how much of the trial were the treated garments effective against attacks by biting insects, mites and ticks.

0 (None)				100% (All the time)	
2	1	3	7	36	A,B,C Coy and Mortar Platoon
			1	1	Recon Patrol

16. Have you been in an environment similar to, or the same as this before?

Never	Once	Twice	Three	More than 3	
2	3	3	3	37	A,B,C Coy and Mortar Platoon
				3	Recon Patrol

17. Did the treated clothes give more protection against insects/mites than your previous experience of untreated clothes.

Yes	No	
44	4	A,B,C Coy and Mortar Platoon
3		Recon Patrol

18. Would you use this repellent again if it became a stock item?

Yes	No
45	5
3	

A,B,C Coy and Mortar Platoon

Recon Patrol

Please give a short explanation for your choice.

## Appendix E

### Control - No Perigen Treatment

#### Questionnaire - Untreated Clothes

One questionnaire is to be filled out by each participant.

Name and identification should be clearly written on the front sheet of the questionnaire.

Questionnaires to be returned to nominated officer on completion.

A number of questions will be asked regarding your use of insect and mite repellent. Questions refer to the Jungle Green shirt and trousers only. Do not include socks, underwear or other clothing items when answering the questions. After each question a series of boxes will be shown with several options to which you should respond with one answer, unless otherwise stated. Indicate your choice by placing a tick in the selected box as shown in the example question below.

Q: Indicate the number of times you used the issued mite repellent during the trial.

	0	1	2	3 or more
A:		✓		

NAME: .....

RANK: .....

UNIT: .....

1. Indicate which of the following is true.  
The same set of Jungle Greens were worn.

All the time  
Half the time, then changed  
Several sets were worn during the trial  
Two sets were rotated on a daily basis

A,B,C Coy  
& Mortar  
Platoon

Recon  
Patrol

47  
28

4  
1

2. Indicate the number of times you washed the Jungle Greens during the trial.

0	1	2	3	4 or more
67	7	2		
2	2	1		

A,B,C Coy & Mortar Platoon

Recon Patrol

3. If whilst wearing the Jungle Greens you were immersed in water, indicate the level of immersion and the frequency at each level.

Below the knee

0	1	2	3	4 or more
30	17	9	13	6
1	1	1		1

A,B,C Coy & Mortar Platoon

Recon Patrol

Above the knee but below the waist

0	1	2	3	4 or more
48	8	7	1	1
2		1	1	1

A,B,C Coy & Mortar Platoon

Recon Patrol

Above the waist but below the chest

0	1	2	3	4 or more
57	3			1
2		2	1	

A,B,C Coy & Mortar Platoon

Recon Patrol

Above the chest

0	1	2	3	4 or more
59	7	1		1
2	1	1	1	

A,B,C Coy & Mortar Platoon

Recon Patrol

4. Describe the weather you encountered during the trial?

Hot/Wet	Cool/Wet	Hot/Dry	Cool/Dry	
		74	2	A,B,C Coy & Mortar Platoon
		5		Recon Patrol

5. Indicate the occurrence of biting insects/mosquitoes which you encountered during the trial.

None	Hardly any	Often	All the time	
	3	39	31	A,B,C Coy & Mortar Platoon
		2	3	Recon Patrol

6. Which one or more of the following is true?

		A,B,C Coy & Mortar Platoon	Recon Patrol
Insect attacks occurred:	Mainly at night	23	
	Mainly at sunset	32	2
	Mainly at sunrise	18	1
	During the day	11	
	All the time	33	2
7. The Jungle Greens were washed:	More than 3 times		
	Three times		
	Two times	2	1
	Once	5	2
	Never	63	2

8. Indicate the number of times you were bitten by insects/fles through the Jungle Greens.

Never	Once	Twice	Often	Very Often	
6	2	3	33	33	A,B,C Coy & Mortar Platoon
			1	4	Recon Patrol

9. Indicate the number of times you applied the issued insect repellent - personal during the trial.

	A,B,C Coy & Mortar Platoon	Recon Patrol
Never	57	4
Once a day	6	1
Twice a day		
Three times a day	4	
More than three times a day	7	



10. Did you use an insect repellent other than the issued item? If so, please indicate the brand, the reason for using this in preference to the issued item, and the number of times it was applied.

	RID	DEET	OTHER (Please specify)
Brand	61		14
	5		

A,B,C Coy and Mortar Platoon

Recon Patrol

Reason for using an alternative insect repellent (please tick)

A,B,C Coy and Recon Patrol  
Mortar Platoon

1	1	Issued item not available
46	4	Brand items are more effective
32	2	Do not like issued item
9		Others (please specify)

Number of times you applied the alternative insect repellent

	A,B,C Coy & Mortar Platoon	Recon Patrol
More than three times a day	15	1
Three times a day	10	
Twice a day	28	2
Once a day	17	2
Never	4	

11. How often did you require first aid or medical treatment for any insect or mite related attack.

0	1	2	3	4 or more	
36	13	14	6	6	A,B,C Coy and Mortar Platoon
2	2			1	Recon Patrol

12. Which of the following is true?  
Insect bites occurred through the Jungle Greens

	A,B,C Coy & Mortar Platoon	Recon Patrol
Very often - more than 10 times	31	4
More than 5 times but less than 10	26	1
Twice	10	
Once		
Never	6	

13. Were you troubled by mites/ticks during the trial?

Never	Hardly ever	Often	Very often	All the time	
6	25	28	6	13	A,B,C Coy and Mortar Platoon
1	2			2	Recon Patrol

14. How frequently did you apply the issued insect repellent - clothing (mite repellent) during the trial?

0	1	2	3	4 or more	
63	3	3	1	6	A,B,C Coy and Mortar Platoon
4		1			Recon Patrol

## **Appendix F**

### **Weather Conditions and Insect Populations**

The exercise held at Shoalwater Bay Training Area was mainly centred around the Raspberry Vale Sector and surrounding areas. Companies A, B and C moved along Shoalwater Creek and surrounding creek beds. The Mortar Platoon were located in adjacent areas to these companies. The Recon patrol were located in the mangrove area around Shoalwater Creek and carried out several sea water immersions during the exercise.

All units took part in a series of exercises which involved levels of activity from very high to light. During the high level activities most people were perspiring heavily and at times their clothing was saturated with perspiration.

No rain occurred throughout the exercise and most days were reported as fine and hot with temperatures between 25-30° C.

The insect population encountered by all the units was mainly mosquitoes, ticks and sandflies. There were several reports of March fly bites and a spider bite. The mosquito population encountered by the Recon patrol was higher than the other units, and was probably due to the environment in which the patrol were located.

## **Appendix G**

### **Comments from the Questionnaire**

Question 18 in the questionnaire for treated clothing asked if the person would use the product again and invited them to make comments concerning their choice. Some of their answers are shown below.

Good product.

It did appear to offer protection against ticks.

Does not require daily application.

The insects were visibly repulsed by the Perigen on the clothing surface, however this usually just redirected them towards the unexposed parts of the body.

It worked well against the insects. There were no side effects - rashes, smell etc.

It appears to be effective as other members of the Coy had numerous bites up arm and chest whilst working in similar areas and conditions without treated clothing.

The repellent in this environment in clothing is not so critical, but in a jungle environment would be better area to test the chemical. I found the repellent effective with what little insect population there is in SWBTA at this time of year.

It works.

## Appendix H

**Table of Fabric Samples analysed by  
Wellcome Australia Limited**

Sample	MRL CONTROL	Blank	Clothing
A	0.30	0.17	
B	0.15	0.21	
C	0.35	0.20	
D	0.23	0.14	
E	0.33	0.15	
F	0.29	0.16	
G			0.09
H			<0.01
I			0.16
J			
K		0.23	
L	0.18		
M		0.07	
N	Untreated cloth for reference < 0.01		

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## ABSTRACT

Since the high activity of biting flies and insects in the Australian terrain may cause subsequent disease or discomfort soldiers must be protected to maintain their efficiency and health. The issued "insect repellent - clothing", while effective, has some undesirable characteristics and is not popular with service personnel.

During a battalion exercise in Northern Queensland the use of a synthetic pyrethroid was investigated with "in the field" application objective. The product used appeared to be effective in bite inhibition, was acceptable to the user and could easily be used for application particularly if pre-measured doses were packaged in sealed sachets.

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